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GB 2239376 A GB 2143660 A US 4511760 A
US 4121049 A

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INT CL[6] G06K 11/06 11/16
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# (54) Rigid plate touch screen

(57) A touch screen, to be superimposed on a display screen to record data or initiate functions in computer or other systems, is an assembly of a rigid, transparent plate 1 with a load sensor 2 mounted at each of its four corners, between the plate 1 and a backplate 3 used to connect the assembly to the display screen of the device with which it is to be used. The backplate usually has a central section 4 removed so as not to obstruct viewing of the display screen. The plates 1,3 are connected at each corner by a flexible fixing 5 designed to allow the transparent plate to move freely in the intended direction for the operation of the load sensors; various types of load sensor are described. Each sensor measures a proportion of the pressure exerted by a finger tip at any point on the transparent plate and the four measures are processed electronically and/or by software to relate the position of the touch point to the underlying display.

FIGURE 1

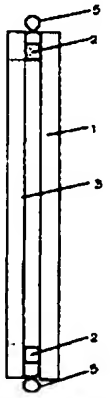


FIGURE 2

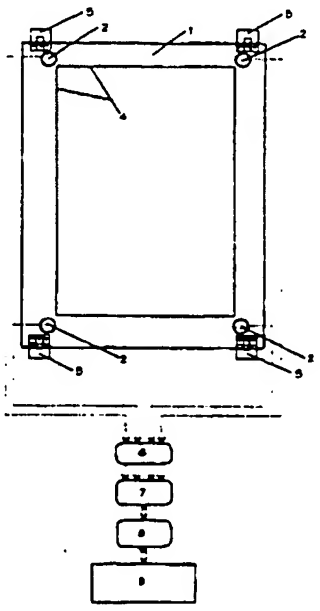


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FIGURE 1

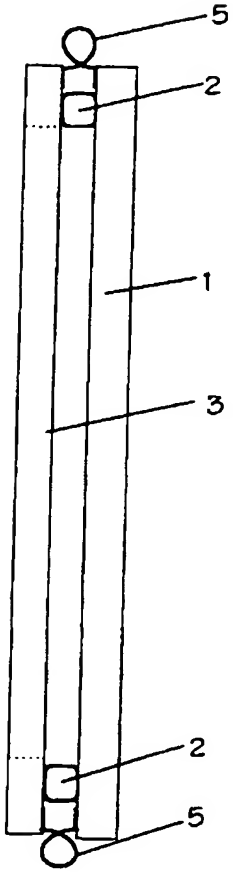



FIGURE 2

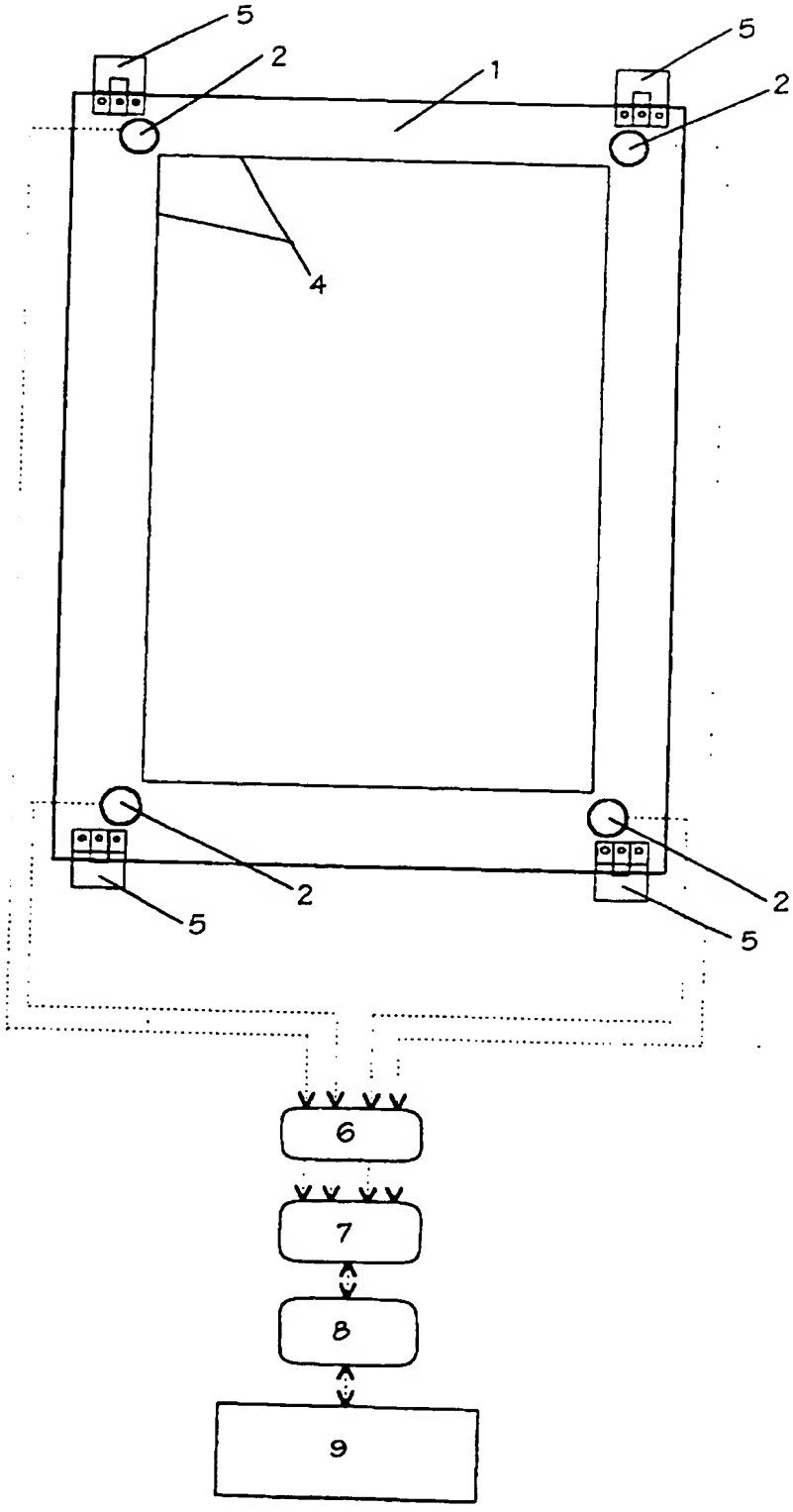


FIGURE 3

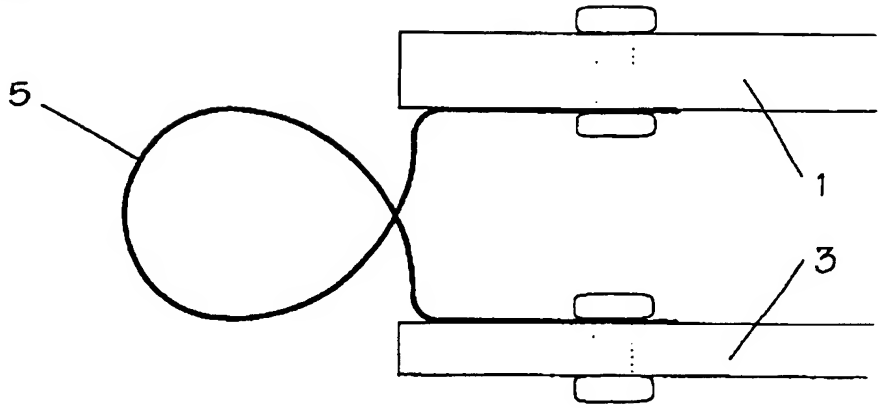



FIGURE 4

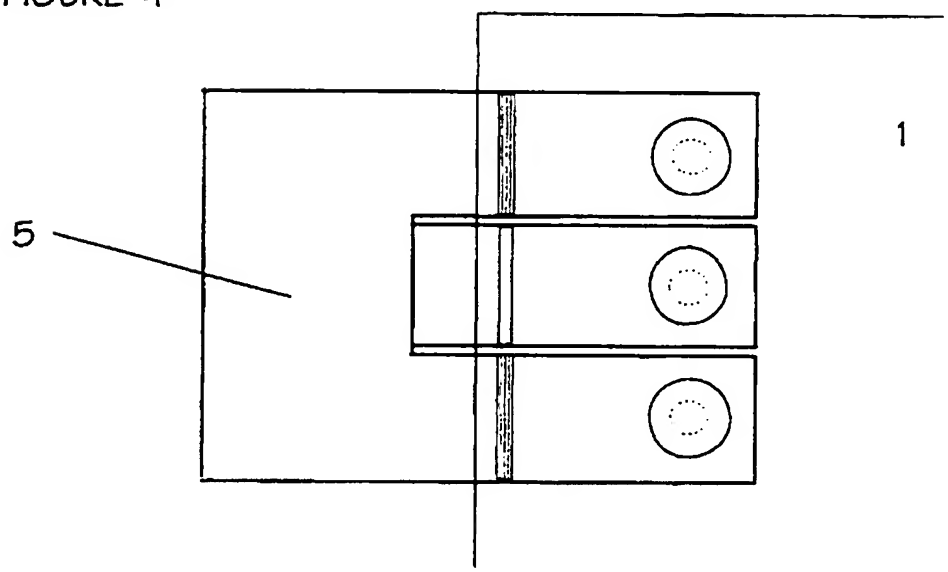



FIGURE 5

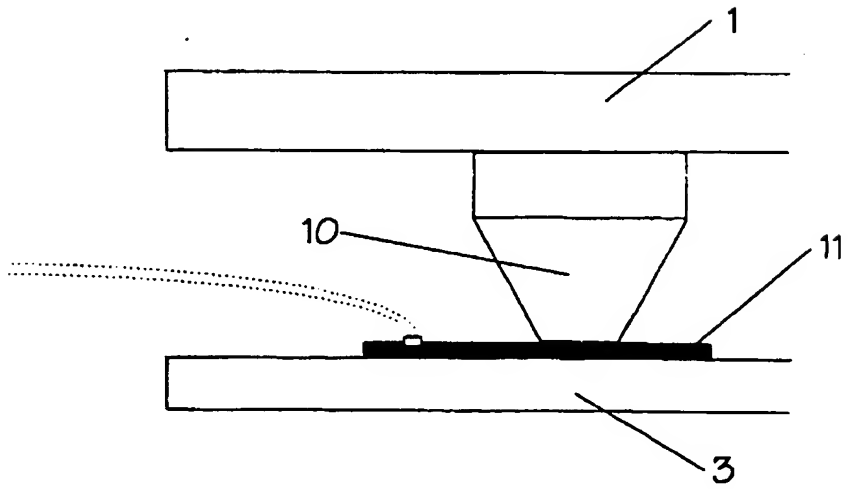


FIGURE 6

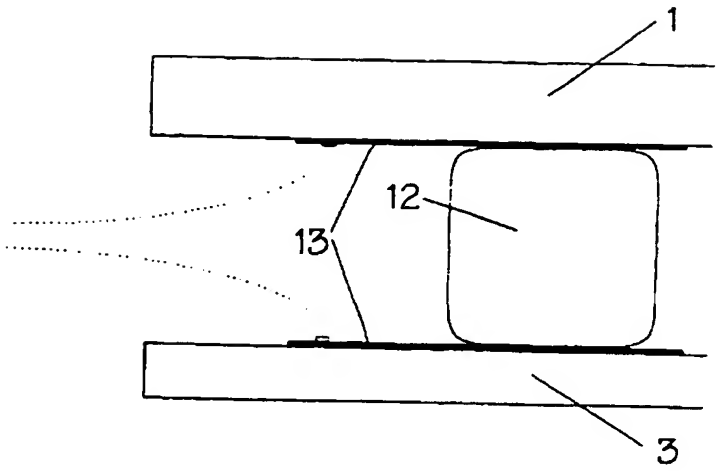



FIGURE 7

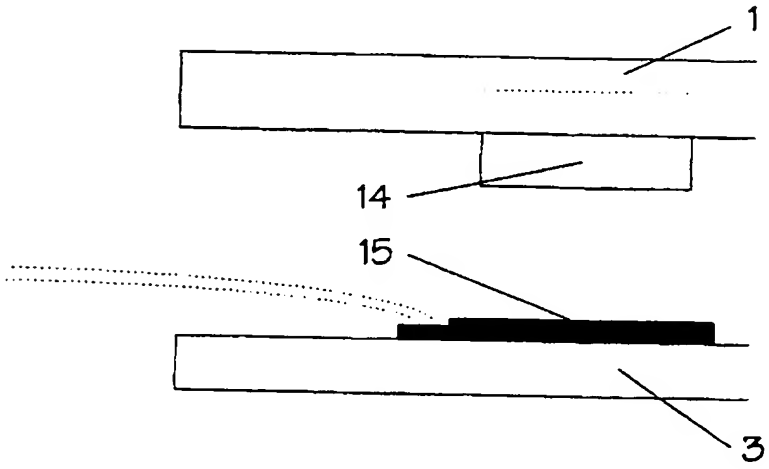



FIGURE 8

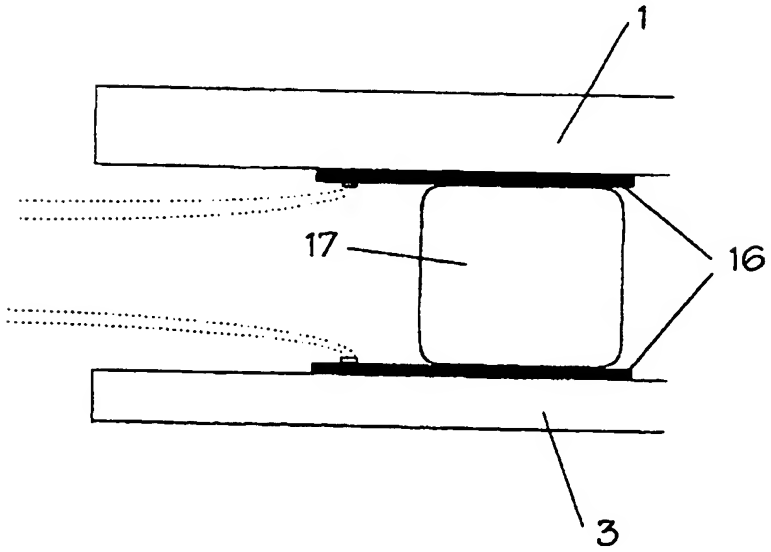
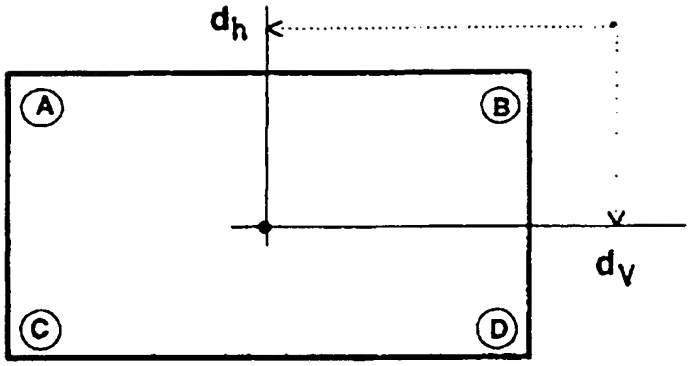


FIGURE 9



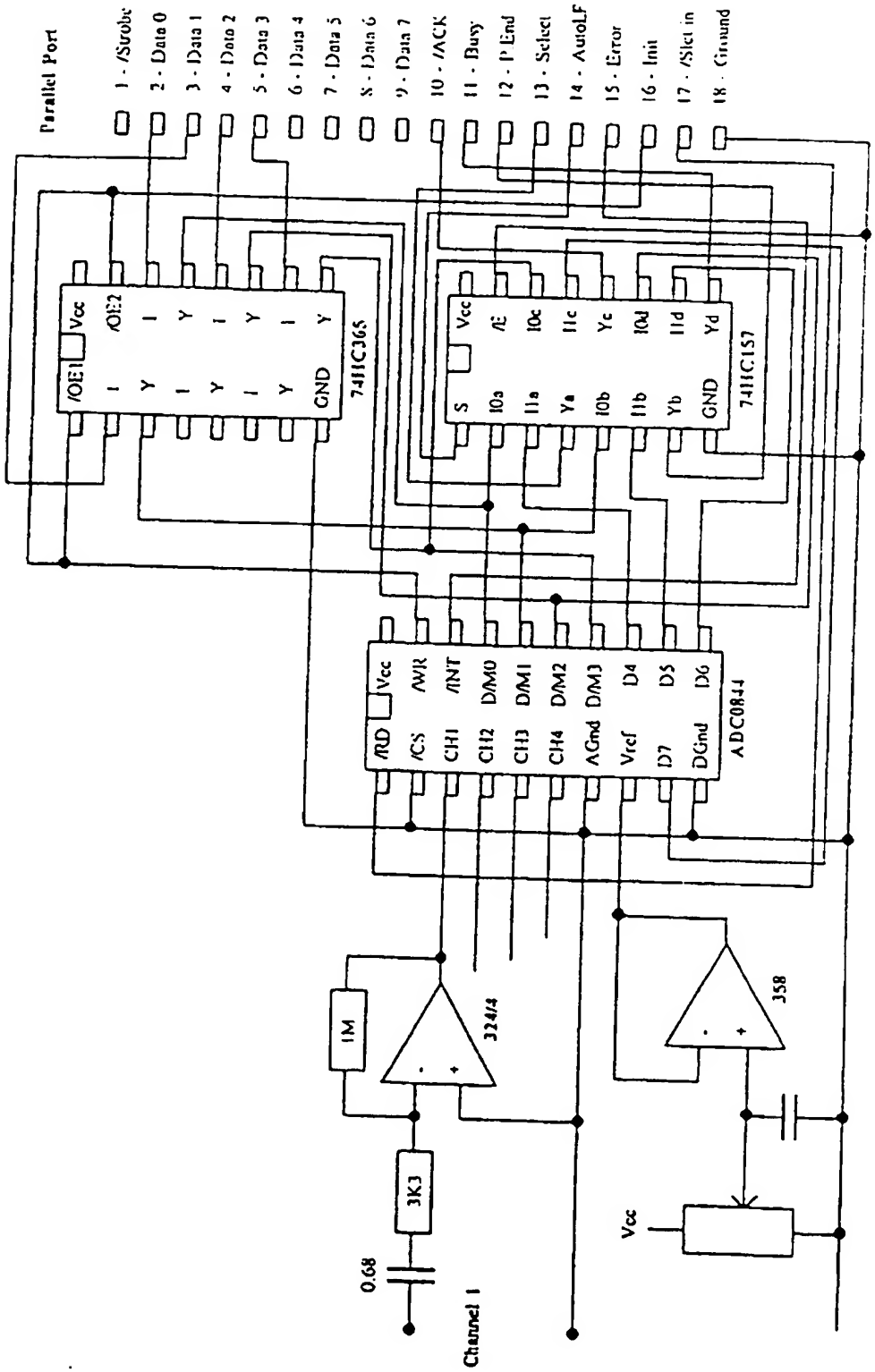

Parallel Port
1 - /Strobe
2 - Data 0
3 - Data 1
4 - Data 2
5 - Data 3
6 - Data 4
7 - Data 5
8 - Data 6
9 - Data 7
10 - /ACK
11 - Busy
12 - P.End
13 - Select
14 - AutoLF
15 - Error
16 - Init
17 - /Slct in
18 - Ground
74HC365
74HC157
ADC0844
1M
324/4
358
3K3
0.68
Channel 1
Vcc

FIGURE 10

# RIGID PLATE TOUCH SCREEN

This invention relates to a rigid plate touch screen

Touch screens are known in electronic data processing, being superimposed on a cathode ray tube or liquid crystal display screens for use as an alternative means to that of a keyboard for an operator to record data and initiate functions in a computer system. Their size can vary depending upon of the display screen they are used with, from the desk top visual monitor screen to the display screen of a hand held computer with the touch screen usually superimposed over the whole of the display screen. Touch screens operate by one or a range of data or function value selection points positioned at various locations on the display screen; the data or function required being selected by finger tip or stylus held in the hand touching a point on the touch screen adjacent to the selection point of the appropriate data or function displayed. The vertical and horizontal location of the touch point on the touch screen is electronically transmitted to the computer system which, from the value of this locational signal, registers the data or function value.

Touch screens are, however, relatively expensive, requiring a high degree of precision and or a controlled environment for their manufacture. Moreover, some designs, because of the nature of the materials used in their manufacture, are prone to wear in use and therefore have a limited operating life. The Rigid Touch Screen's advantages are that its components are readily available in the market and easily manufactured and assembled by conventional means. That part of the device which subject to touch is rigid and of a strong material which will provide for a long operating life when used as intended.

According to the present invention there is provided a touch screen device comprising, usually, a rectangular rigid plate of transparent material with surface dimensions suitable to extend to those of the display screen it is to be used with or beyond it, four load sensor mechanisms, one being fixed

to each corner of the transparent plate, measure the proportion of the load exerted at that corner by a single finger tip load on a point on the transparent plate, a rigid back plate of the similar outline shape and size as the transparent plate also secured to the four load sensor mechanisms so as to provide a support to the functioning of the transparent plate and load sensor mechanisms, the back plate, optionally, has a section removed from its centre to allow a display screen positioned behind the device to be seen when looking through the transparent plate or alternatively a flat liquid crystal screen is positioned between the transparent plate and the back plate, the back plate is also used to secure the assembly to the host device with which it is being used, four flexible fastenings adjacent to the corners of the transparent plate secure the transparent plate to the back plate in a way which holds them in alignment whilst allowing the transparent plate free movement in its intended plane of operation and does not inhibit the operation of the load sensor mechanisms, a series of electronic components and circuitry attached to a power source and connected to the 4 load sensor mechanisms which continuously measure the electrical outputs of each of the 4 sensors amplifying the measurements and converting the measurements from analogue to digital signals for transmission to the host computer system.

A specific embodiment of the invention will now be described by way of example with reference to the accompanying drawings in which :-

Figure 1 shows the side view of the main part of unit;

Figure 2 shows the front view of the unit with the main electronic components;

Figure 3 shows the top view and Figure 4 the side view of one type of design for the retaining spring;

Figure 5 shows one option for the load sensor mechanism utilising a piezo-electric plate and rubber contact plug;

Figure 6 shows one option for the load sensor mechanism utilising a electrically conductive rubber contact plug;

Figure 7 shows one option for the load sensor mechanism utilising a permanent magnet and electro magnetic or Hall effect sensor;

Figure 8 shows one option for the load sensor mechanism utilising capacitive strips separated by a layer of flexible insulating material;

Figure 9 is a diagram which illustrates the mathematical principles on which the functioning of the invention is based.

Figure 10 shows a schematic diagram of one option for the invention's electronic components and circuitry.

Referring to the drawings the rigid plate touch screen assembly, shown in Figure 1 from the side view and Figure 2 from the front view, comprises a rigid rectangular transparent plate 1 with, fixed at each of the four corners of its rear surface, load sensor mechanisms 2. A back plate 3 with the same shape and surface dimensions as the transparent plate 1 is also fixed at the four corners of its front surface to the load sensor mechanisms 2 so that the front surfaces of the transparent plate 1 and back plate 3 are parallel. The back plate 3 has a rectangular section 4 removed from its centre to allow an electronic display screen positioned behind the device to be seen through the transparent plate 1, the rectangular section 4 being the same size as the display screen. The back plate 3 is

that part which is used, with the appropriate fixings, to attach the device to a host unit such as the housing for an electronic display screen. To hold the transparent plate 1 and the back plate 3 together and in alignment whilst also allowing the transparent plate 1 to move freely within a limited range in the intended plane of operation are four spring fixings 5 secured to the transparent plate 1 and back plate 3 at positions adjacent to their four corners, Figure 3 shows the side view and Figure 4 the plan view of such a spring fixing 5.

The functioning of the touch screen is effected by a finger tip or hand held stylus exerting a light load at a single point at any position on the front surface of the transparent plate 1 with the resultant proportion of the load at each of the four load sensors 2 being a factor of the amount of the load at the single point on the surface of the transparent plate 1, constant for all load sensors 2, and its distance from the load sensor 2, a measure of the load on each load sensor being a change in the electrical signal generated by the mechanism of the load sensor 2.

One option for the design of the load sensor(s) 2, shown in Figure 5, comprises a rubber contact plug 10 secured to the rear surface of the transparent plate 1 and resting on the surface of a piezo-electric plate 11 which is secured to the front surface of the back plate 3. A load on the transparent plate 1 presses the rubber plug 10 against the piezo-electric plate 11 inducing a change in the magnitude of a small electric potential between the electrodes of the piezo-electric plate 11, the amount of change dependant on the amount of the load on that sensor, transferred through the rubber plug 11.

One option for the design of the load sensor(s) 2, shown in Figure 6, comprises a conductive rubber plug 12 secured between two electrode strips 13, one strip secured to the transparent plate 1, the second to the base plate 3, a small electric current passing through the conductive rubber plug 12 via the two electrodes 13. A load on the transparent plate 1 compresses the conductive rubber plug changing the magnitude of the current passing from one electrode 13, through the conductive rubber

plug 12, to the second electrode 13. The amount of change is dependant upon the amount of the force on the sensor 2.

One option for the design of the load sensor(s) 2, shown in Figure 7, comprises a permanent magnet 14 secured to the rear surface of the transparent plate 1 and an electro-magnetic device 15, which has a small electric current passing through it, attached to the front surface of the back plate 3. The transparent plate 1 and the back plate 3 are so arranged that there is a gap between the permanent magnet 14 and the electro-magnetic device 15. A load on the transparent plate 1 moves the attached permanent magnet 14 towards the electro-magnetic device 15 causing a change in the magnitude of the electric current. The amount of change is dependant upon the amount of the load, on that part of the transparent plate 1 where the assembly is located, and the corresponding amount of movement of the permanent magnet 14 towards the electro-magnetic device.

One option for the design of the load sensor(s) 2, shown in Figure 8, comprises two conductive plates 16, having an electric potential between them. One plate 16 is attached to the rear surface of the transparent screen 1 the second plate 16 attached to the front surface of the base plate 3. Attached to and separating the two plates 16 is a soft, flexible layer of insulating material 17. A load on the transparent plate 1 compresses the flexible layer 17 reducing the space between the two conductive plates and changing the magnitude of the electric capacitance between the plates 16. The amount of the change is dependant upon the amount of the load on the sensor that compresses the flexible layer 17 and the resultant amount of reduction in the space between the two plates 16.

Figure 9 shows a diagrammatic representation of the front face of the invention where A, B, C, D are the load sensor 2 locations and T is a point on the surface of the transparent plate 1 where a finger tip load can be exerted. Taking an origin at the corner of the transparent plate 1 nearest sensor A, the displacement $d_v$ of the touch point T down the screen is given by :

$$d_V = \frac{S_C + S_D}{S_A + S_B + S_C + S_D}$$

and the displacement $d_h$ across the transparent plate 1 is given by :

$$d_h = \frac{S_B + S_D}{S_A + S_B + S_C + S_D}$$

Where $S_A$, $S_B$, $S_C$, $S_D$ are the magnitude of the signals from the sensors at the locations indicated by A, B, C, D.

The absolute load exerted at the touch point T is not a factor in the above expression, so the locational accuracy of the touch screen is maintained over wide range of touch point loads.
Alignment of the touch point position with the size and format of the selection display is accomplished by introducing a scaling factor and offset which result from a simple set up procedure where a user is prompted to touch a predetermined point on the transparent plate's surface.

The load on each of the load sensors 2 measured by changes in the magnitude of electrical signals generated by them is processed by a range of electronic components. A schematic diagram of the components configuration is shown in Figure 10.

## CLAIMS

## RIGID PLATE TOUCH SCREEN

1. A rigid plate touch screen device comprising, usually, a rectangular rigid plate of transparent material with surface dimensions suitable to extend to those of the display screen it is to be used with or beyond it, four load sensor mechanisms, one being fixed to each corner of the transparent plate, measure the proportion of the load exerted at that corner by a single finger tip load on a point on the transparent plate, a rigid back plate of the similar outline shape and size as the transparent plate also secured to the four load sensor mechanisms so as to provide a support to the functioning of the transparent plate and load sensor mechanisms, the back plate, optionally, has a section removed from it centre to allow a display screen positioned behind the device to be seen when looking through the transparent plate or alternatively a flat liquid crystal screen is positioned between the transparent plate and the back plate, the back plate is also used to secure the assembly to the host device with which it is being used, four flexible fastenings adjacent to the corners of the transparent plate secure the transparent plate to the back plate in a way which holds them in alignment whilst allowing the transparent plate free movement in its intended plane of operation and does not inhibit the operation of the load sensor mechanisms, a series of electronic components and circuitry attached to a power source and connected to the 4 load sensor mechanisms which continuously measure the electrical outputs of each of the 4 sensors amplifying the measurements and converting the measurements from analogue to digital signals for transmission to the host computer system.

2. A rigid plate touch screen device as claimed in Claim 1 wherein the transparent plate and back plate are secured together by flexible fixings which hold them in alignment whilst allowing the transparent plate free movement in its intended plane of operation.

3. A rigid plate touch screen device as claimed in Claim 1 wherein the load sensor means is provided by the load on the transparent plate being transferred via a rubber plug to a piezo-electric plate changing the magnitude of the current passing through the piezo-electric plate.

4. A rigid plate touch screen device as claimed in Claim 1 wherein the load sensor means is provided by the load on the transparent plate being transferred via an two electrodes separated by a conductive rubber plug, the compression of the conductive rubber plug changing the magnitude of the small electric current passing through the two electrodes and conductive rubber plug

5. A rigid plate touch screen device as claimed in Claim 1 wherein the load sensor means is provided by a permanent magnet secured to the rear surface of the transparent plate which is moved by a load on the transparent plate towards an electro-magnetic cell, changing the magnitude of an electric current passing through the electro-magnetic cell.

6. A rigid plate touch screen device as claimed in Claim 1 wherein the load sensor means is provided by two conductive plates positioned in parallel, each having an electric current passing through them and separated by a layer of soft, flexible insulating material. A load exerted on the assembly compresses the flexible material, reducing the gap between the conductive plates and changing the magnitude of the electric capacity of the plates.

7. A rigid plate touch screen device as claimed in Claim 1 wherein there is a section removed from the centre of the back plate to allow the device to be mounted for use over the display area of a cathode ray tube monitor or liquid crystal display screen.

8. A rigid plate touch screen device as claimed in Claim 1 wherein a liquid crystal display screen is positioned between the transparent plate and back plate being secured to the rear surface of the transparent plate so that the selection display is as close is possible to the touch surface of the device.

9. A rigid plate touch screen device as claimed in Claim 1 wherein the transparent plate is replaced by a rigid plate containing a permanent arrangement of selection points.

10. A rigid plate touch screen device substantially as described herein with reference to Figures 1 - 10 of the accompanying drawing.

The Patent Office

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**Application No:** GB 9616826.5
**Claims searched:** 1-10

**Examiner:** M. G. Clarke
**Date of search:** 2 October 1996

## Patents Act 1977
## Search Report under Section 17

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): G1N NAQB; H4T TAFA

Int Cl (Ed.6): G06K 11/06, 11/16

Other: Online: WPI

**Documents considered to be relevant:**

| Category | Identity of document and relevant passage | | Relevant to claims |
|---|---|---|---|
| Y | GB2239376A | IBM - whole document but see especially page 6 | 3,4,7 |
| X | GB2143660A | Matsushita - see especially Figs. 2,3 | 1 at least |
| X<br>Y | US4511760 | assigned to IBM - see especially Figs. 2-4 and pages 7,8 | 1-3 and 7.<br>1-3, 4, 7 |
| X | US4121049 | assigned to Raytheon Co - see especially Figs. 1-7 | 1,2 at least |

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|---|---|---|---|
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